Journal of the Lepidopterists' Society
47(2), 1993, 106–113

SCOLIOPTERYX LIBATRIX (NOCTUIDAE) AND *TRIPHOSA HAESITATA* (GEOMETRIDAE) IN CAVES IN MANITOBA, CANADA

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ABSTRACT. The trogloxene moths *Scoliopteryx libatrix* and *Triphosa haesitata* found in small caves in Manitoba, Canada, were studied over a two year period. Fewer individuals of the latter species were found (126:54), but both species overwintered in caves in which the temperature remained above freezing. *Triphosa haesitata* tended to seek sites further from the cave entrance and preferred slightly warmer air temperature and greater relative humidity than *S. libatrix*. These findings may be related to the fact that *T. haesitata* is near the northern limit of its range. Noteworthy was the finding that some specimens (about 10%) of both species remained in the caves throughout the year. These may represent a portion of the population that spends a second concurrent winter underground prior to leaving the caves the following spring. In the laboratory, at cave temperature (5°C), adult *S. libatrix* remained viable up to 14 months after capture.

Additional key words: ecology, humidity, temperature.

In Manitoba there are three areas where bedrock dissolution has produced such features as the famous "snake pit" sinkholes and the more recently discovered myriad of small caves. The caves are located in three areas: near Gypsumville, Hodgson, and Grand Rapids in the Interlake region of the Province (Fig. 1). Sweet et al. (1988), Voitovici and McRitchie (1989), McRitchie and Voitovici (1990), and McRitchie (1992) describe these caves in detail.

Two moth species were seen repeatedly in 16 of 26 caves investigated. A widespread Holarctic species, the herald moth, *Scoliopteryx libatrix* (L.), was observed in 14 caves and a second species, the tissue moth, *Triphosa haesitata affirmaria* Walker, was noted at 10 of the 26 caves investigated. Findings in the current study support those described earlier by Banta (1907) in America, and Roeder and Fenton (1973) in Canada, on *S. libatrix*. Kowalski (1965) also provided similar ethological and ecological data on *S. libatrix* and *Triphosa dubitata* L. in Poland. Peck (1988) and Peck and Christiansen (1990) refer to these species as trogloxene, meaning they use caves regularly to overwinter but are unable to complete their life cycle within the caves. This paper reports information gathered on these moths; no other insects were observed regularly in the Manitoba caves.

Methods and Materials

Twenty-six caves were investigated for the presence of insect life. Sixteen caves were selected for further study as these repeatedly contained either or both species of moths. From April 1989 to October 1990 I visited these 16 caves at least twice and one site known as Window

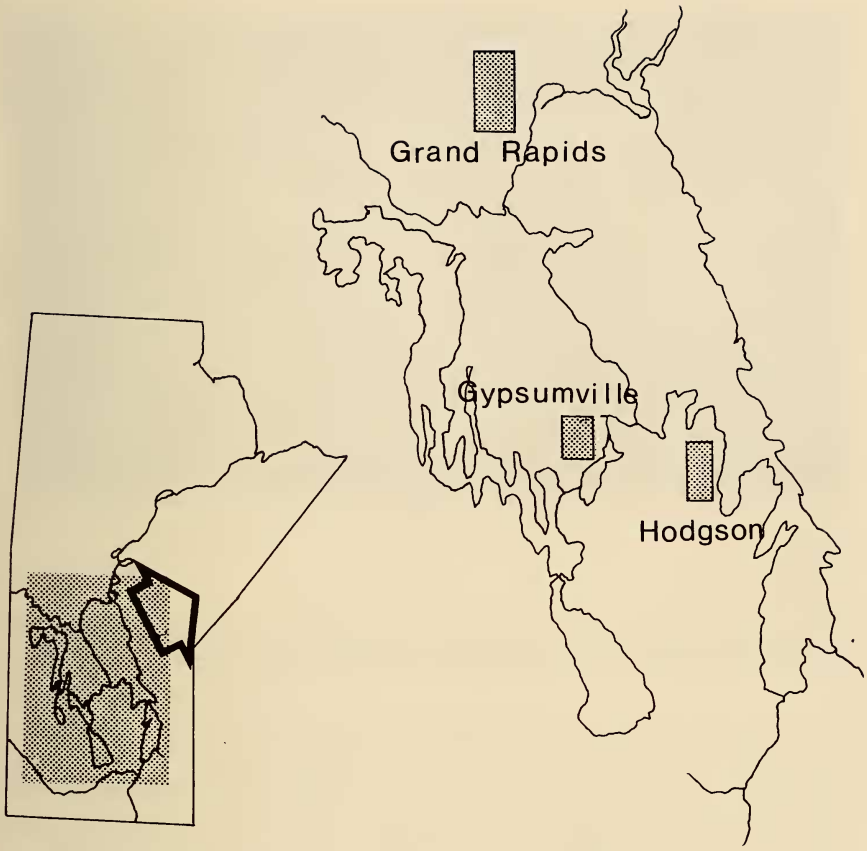

FIG. 1. The location of major cave regions in Manitoba, Canada.

Cave was visited four times. The presence and number of each species of moth was recorded. Voucher specimens were collected and deposited in the Manitoba Museum of Man and Nature. Air temperatures were measured in the caves routinely both years using hand held thermometers, while minimum/maximum thermometers were used in Firecamp and Window caves. Relative humidity measurements were taken using a portable psychrometer (Model 566-3 Bendix Psycron) in the 1990 field season. The presence of air currents was monitored by observing the smoke trail from an extinguished match. Live specimens of *S. libatrix* and *T. haesitata* were taken to the laboratory for further study.

RESULTS AND DISCUSSION

Moths were among the few insects observed in the caves and the only insects studied in detail. Other notable finds included members of

TABLE 1. Physical features of 16 selected caves.

Cave location and name	Length (m)	Depth (m)	Opening		*S. libatrix*	*T. haesitata*
			1	2		
Gypsumville						
Crystal Kingdom	21.0	3.8		*	*	
Long Crawl	125.5	3.0	*		*	*
Maze	76.5	1.2		*	*	
Chamber	55.0	1.4		*	†	*
Stormcloud	—	—	*		*	
Phantom Bear	39.5	5.5		*	*	*
Grand Rapids						
Squeaky	15.5	6.2	*		*	*
Knoll Chimney	19.0	14.0	*			*
Dale's	35.5	5.5	*		*	*
Bear	7.5	3.5	*		*	
Microwave #1	24.6	9.8	*		*	
Microwave #2	25.0	10.0	*		*	*
Firecamp	26.0	8.0	*		*	*
Ice	10.5	5.0	*		*	*
Hodson						
Window	67.6	7.9	*		*	*
Bat's Cave	165.3	12.5	*		*	

* The presence of a particular attribute or species.
† In 1991 the Speleological Society of Manitoba (McRitchie 1992) observed *S. libatrix* in Chamber cave but no additional data was recorded, and so this finding is of distributional interest only.

the Diptera: a new species of midge closely related to *Camptocladius stercorarius* (Degeer) (Chironomidae) currently thought to be a monotypic genus which breeds in dung; *Exechiopsis* sp. (Mycetophilidae) frequently found in cavities on the forest floor; and *Anopheles earlei* Vargas (Culicidae) known to overwinter in caves (Price et al. 1960).

Both species of moths were taken in each of the three areas of caves. Covell (1984) lists the food plants for *S. libatrix* as willow and poplar (Salicaceae), both of which were abundant at all cave sites. The food plants listed for *T. haesitata* are not in the area or are nearing their northern distributional limit. The documented host plants, including wild plum (Rosaceae), oak (Fagaceae), and barberry (Berberidaceae), were not found here, while buckthorn (Rhamnaceae) and hawthorn (Rosaceae) are rare. This may explain, in part, the greater total number of *S. libatrix* found in the caves.

Although individuals of the two moth species were not observed moving in or out of the caves, the numbers of both species increased in the autumn and declined in spring as recorded by both Banta (1907) and Kowalski (1965). Within the caves movement of individual moths was observed, although this was very local and limited to only a few cm over a season. Kowalski (1965) noted much greater movements within caves subject to rapid temperature shifts, but in caves with a

FIG. 2. Two specimens of *Scoliopteryx libatrix* on the ceiling of Window Cave.

temperature regime like that of the Manitoban caves movement was restricted to simply changing orientation or moving but a few cm, findings similar to mine.

While the majority of moths left the caves in spring, some remained in the caves throughout the summer. Nine *S. libatrix* and six *T. haesitata* were observed in the twelve caves investigated in the summer. I initially believed that these individuals would leave the caves, but by autumn they remained where they had been in the spring. Both Banta (1907) and Kowalski (1965) commented on finding dead, fungus covered moths in caves. Although approximately half a dozen dead, fungus covered moths were observed during the study, the individuals that remained in the caves throughout the summer appeared viable. These moths may represent a portion of the population that hibernates over two successive winters thereby providing these species with an alternate life history strategy that may be important in the harsh northern climate. Alternately, they may simply have a higher activity threshold temperature and do not respond to the slight warming temperatures in spring. Nevertheless, specimens of both species taken into the laboratory in late summer and held at a temperature of 5°C with high humidity (90–100%) survived to the following spring, suggesting an ability to overwinter for two successive winters. Adult *T. haesitata* remained viable for 8–10 months while *S. libatrix* lived for slightly longer periods. No specimens of either species lived beyond 14 months in captivity. Hence, it is unlikely a second summer can be passed in the caves.

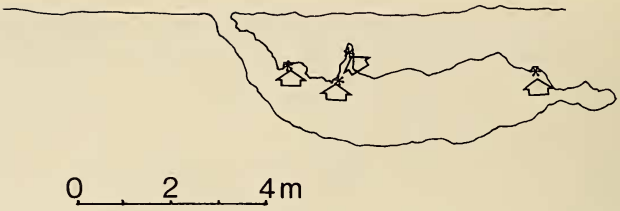

FIG. 3. A cave schematic showing sites where the two moth species frequently hibernate.

Specifications for the various caves investigated are provided in Table 1. Twelve of the caves have a single entrance but four had two or more entrances. In the latter category, slight air currents were encountered confirming connection with the surface although the other entrances could not always be found. Moths were not observed in such "open" sites but were found in side caverns or cul-de-sac passages. The distance from the entrance to the location of the individual moths varied between species. *Scoliopteryx libatrix* was found somewhat closer to the opening, i.e., 1–10 m ($\bar{x}$ = 3.8 m), while *T. haesitata* usually was found further into the caves, i.e., from 2.5–12 m ($\bar{x}$ = 5.2 m). Both species stayed within the proximity of the entrance.

Moths were observed in dry areas of the caves, often near the ceiling, and usually in groups numbering two to six individuals in close prox-

FIG. 4. General nature of cave interior showing cul-de-sac side passages and ceiling features including rocky ridges and algal growth.

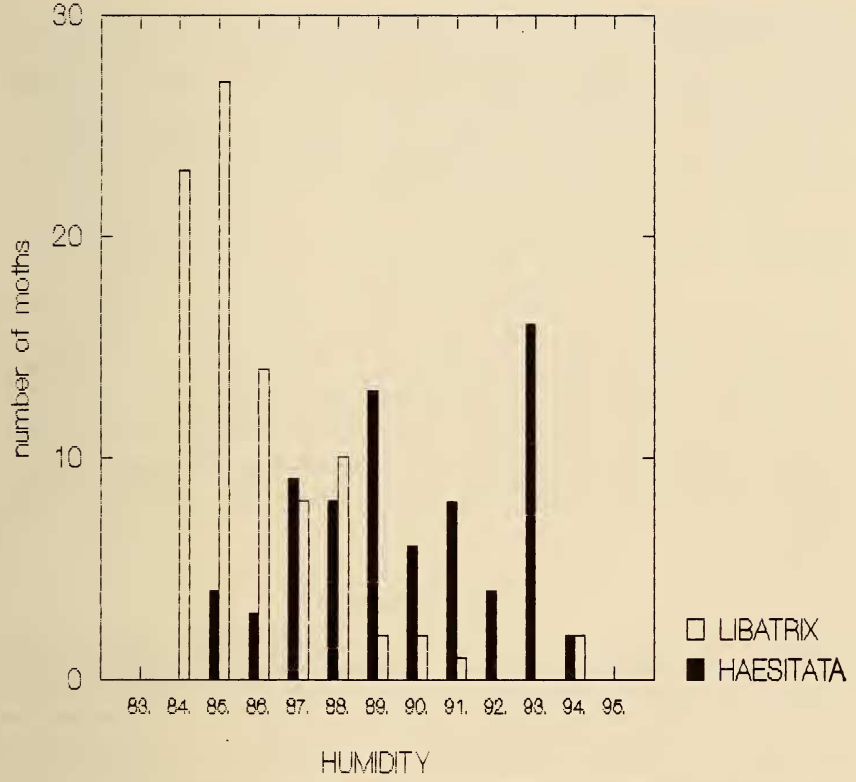

FIG. 5. The distribution of *Scoliopteryx libatrix* and *Triphosa haesitata* in relation to humidity.

imity (Fig. 2), a finding similar to that of Kowalski (1965). Sites most frequented were dry, hollowed out ceilings, tubes running vertically up from the ceiling, and areas just beyond rock lips on the ceiling (Figs. 3 and 4). Little air current was noted here despite being near the entrance of the caves. Low light levels and algal growth often were evident within a meter or two of these sites (Fig. 4). Whereas the relative humidity in the caves varied, only those caves with humidity in excess of 84% contained moths. Figure 5 shows the number of moths collected in relation to relative humidity. *Triphosa haesitata* favored sites with somewhat higher humidity, with the majority in the 87–93% range; most *S. libatrix* were taken in the 84–88% range. Like Kowalski's (1965) findings, water droplets frequently were observed on the moths' bodies and wings, but unlike his findings ice crystals were not seen on the moths because cave temperatures in which overwintering moths were observed remained above freezing.

Caves containing moths maintained a narrow above-freezing temperature regime throughout the year, with a mean of 5.4°C and a range of 3–9°C, while ambient temperature outside was ± 40°C. Firecamp and Window caves had annual minimum/maximum temperature ranges of 5.5/7.5°C and 4.8/8.9°C respectively. The air temperature in caves increased slowly in spring, and between April and June warmed from 3°C to 6°C with a mean of 5°C. During the summer, twelve caves, including Crystal Kingdom, Long Crawl, Maze, Squeaky, Dale's, Bear, Microwave #1, Microwave #2, Firecamp, Ice, Window, and Bat's Cave were visited, and these remained between 6–9°C. The mean air temperature in areas occupied by moths during the eight month period from April to November during both years was 6.5°C for *S. libatrix* and 7.4°C for *T. haesitata*. In September to November the caves cooled from 9.0°C to 3.5°C with a mean of 6.2°C. My findings support those of Banta (1907) who noted that cave temperatures in spring when *S. libatrix* leave Mayfield's cave were cooler than when they return in the autumn.

ACKNOWLEDGMENTS

I thank W. M. McKillop and the many members of the Speleological Society of Manitoba, especially J. Dubois and D. McRitchie, for field assistance. R. Brust of the University of Manitoba verified the identification of *A. earlei*, and B. Bilyj of the Freshwater Institute, Winnipeg, identified the other dipteran species. I am grateful to A. R. Westwood and two anonymous reviewers for helpful comments on the manuscript. The Manitoba Museum of Man and Nature Foundation and The Manitoba Heritage Federation Inc., provided grants in support of this research.

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Received for publication 4 March 1992; revised and accepted 20 December 1992.